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GROWING
RYE *in the*
WESTERN
HALF *of the*
UNITED
STATES



THE PRODUCTION OF RYE in the United States has increased rapidly during the past few years, due chiefly to a heavy foreign demand, high-priced labor, low yields of wheat, and the development of improved varieties of rye. Rye is grown largely as a cash grain crop in the western half of the United States, but is used also for pasture, as a green-manure or nurse crop, and to smother weeds.

The growing of winter rye permits a better distribution of labor, because it can be sown in grain stubble in the fall and is harvested before other grains are ripe. Winter rye can be grown on grain stubble, corn ground, fall-plowed land, or summer fallow. Sowing on grain stubble often is the most profitable because of the cheaper cost of production.

Winter rye should be sown about August 15 to September 1 in the northern part of North Dakota and Minnesota, but later dates of sowing usually give better results south of this section. Spring rye should be sown as early as is feasible. Rye should be sown with a grain drill at the rate of 4 to 6 pecks per acre. It usually is harvested and threshed like other small grains.

Rye can be grown in practically all parts of the United States, but is most profitable in the Northern and Eastern States. Winter rye is the hardiest and earliest of all cereals and successfully survives the winters in the cold northern section of North Dakota and Montana.

Both winter and spring varieties of rye are grown, but the latter are of minor importance. The Rosen variety is best adapted to Michigan and the Corn-Belt region, but is less productive than other varieties in the cold northern sections, in semiarid sections, and in the South. Dakold (N. Dak. No. 959), a very hardy winter variety, is the most productive rye in North Dakota and northern Montana. Swedish (Minn. No. 2) has given the highest yields in Minnesota, and Advance in the eastern half of South Dakota. Two selections from the Schlanstedt variety, Wisconsin Pedigree Nos. 2 and 12.19, have yielded best in Wisconsin.

Much of the rye crop of the United States is shipped abroad and the remainder is mostly ground into flour.

Grasshoppers often injure rye, and ergot causes considerable loss.

GROWING RYE IN THE WESTERN HALF OF THE UNITED STATES.¹

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INTRODUCTION.

THE PRODUCTION OF RYE in the United States has increased rapidly within the past few years. This increase is illustrated by the maps (Figs. 1 and 2), showing the distribution of rye in this country in 1909 and 1919. The increase in production is due chiefly to a heavy foreign demand, high-priced labor, low yields of wheat, and the development of improved varieties of rye, including Rosen, Dakold, and several others. The hardiness, vigor, earliness, and low production costs of winter rye have permitted it to compete successfully with spring wheat. Recent low prices for rye, however, have made the crop less profitable than formerly. If rye is to maintain its importance in the future it must be fitted into its proper place in the farming system. Suitable cultural methods and good varieties are equally essential. A continued foreign market for our surplus also is necessary. These problems are discussed in this bulletin.

PLACE OF RYE IN THE FARMING SYSTEM.

Rye is grown very largely as a cash grain crop in the western half of the United States, and it thus competes directly with wheat, oats, and barley. Where winter wheat is hardy enough to survive the winters it usually outyields rye. Winter wheat, however, can not yet be grown successfully in most parts of North Dakota, Minnesota, and South Dakota, and in these States and at the higher altitudes in the intermountain region and on sandy soils in these and other States winter rye is more productive. Rye frequently outyields spring wheat in dry sections on sandy soils, and in unfavorable seasons during which rust reduces wheat yields. Under conditions not favorable to barley and oats, rye often is a more profitable crop.

¹ For information concerning the culture of rye in other parts of the United States, see Farmers' Bulletin 756, Culture of Rye in the Eastern Half of the United States, and Farmers' Bulletin 894, Rye-Growing in the Southeastern States.

Rye is a valuable green-manure crop where green manuring is a profitable practice, chiefly because of its rank growth and its adaptation to low temperatures, which enable it to grow in late fall and early spring. Green manuring is not profitable in the semiarid regions but is frequently practiced in the orchards of California. Rye can be sown on poor soil or on a poorly prepared seed bed without much expense, but it responds well to more favorable conditions. It can be grown alone or in mixtures with legumes, such as vetch, for plowing under.

On sandy soils which have a tendency to drift or blow, rye often is the only crop which can be grown successfully. Rye is better adapted to sandy soils than any other grain crop. Plowing under rye to bind the soil while another crop is becoming established is a common practice on new irrigated sandy lands.

Rye, especially when mixed with vetch or peas, is a valuable soiling crop, or green feed, in some sections. It makes a good growth in early spring, before other crops are well started, and often produces high yields of forage.

In many sections of the western United States rye is of chief importance as a pasture crop. On nonirrigated lands in Kansas, Nebraska, Colorado, Montana, Idaho, and parts of other States it is especially useful for this purpose. Its vigorous fall growth allows it to be more heavily pastured in the autumn than wheat. It makes a good growth in the spring and can be pastured until the crop is nearly mature. If enough of the crop remains it can be harvested for grain. Where soil moisture and climatic conditions are favorable spring rye sown in the summer makes abundant fall pasture.

Rye often is successfully used as a nurse crop for legumes, especially alfalfa and sweet clover. Its earliness enables it to be harvested in time to avoid smothering the legume crop. Under certain conditions rye is less desirable as a nurse crop than barley or early varieties of oats, however, because of its rank growth and its heavy draft on soil moisture and fertility.

The rank growth, early vigor, and heavy tillering of rye make it useful as a smother crop to keep down wild oats and many other weeds. Rye ripens early and usually can be harvested before wild oats mature. It thus is a valuable aid in the control of this noxious annual weed pest.

One of the principal advantages of rye, especially in the Dakotas, is that it allows a better distribution of labor and a consequent increase in the acreage of crops which can be handled with a given farm equipment. If rye is drilled into small-grain stubble in the fall without previous preparation, no expense is incurred except for seed and seeding. It matures early and is harvested before any of the spring grains are ready to cut. The farmer is thus enabled to carry on his other operations at the proper time because the rush of fall plowing and spring seeding is lessened, or he may increase his area of crops as a result of seeding part of his land to rye. The little labor required to produce rye by the above method often makes the crop a profitable one, although, as mentioned later, the grasshopper menace may be increased. The sowing of winter rye in stubble also is advantageous when farm labor is scarce or high in price.

There are some disadvantages in growing rye, the principal one being its tendency to volunteer. The seed shatters rather easily, so that some is always scattered on the land on which this crop has been grown. This comes up and grows with the subsequent crop. The rye matures earlier than other grains, and some of the seed is again shattered before the crop is harvested. It is therefore very difficult to eradicate rye in a system of continuous small-grain farming. The mixture of appreciable quantities of rye in wheat lowers the market grade and consequently the price of wheat. Wheat should not be sown on land which produced rye the previous season. If followed by a tilled crop, such as corn, most of the volunteer rye will be eradicated.

The sowing of winter rye in grain stubble increases the grasshopper menace to some extent, although this increase has doubtless been overemphasized. The grasshoppers may deposit their eggs in a stubble field which is later sown to rye without plowing. To plow

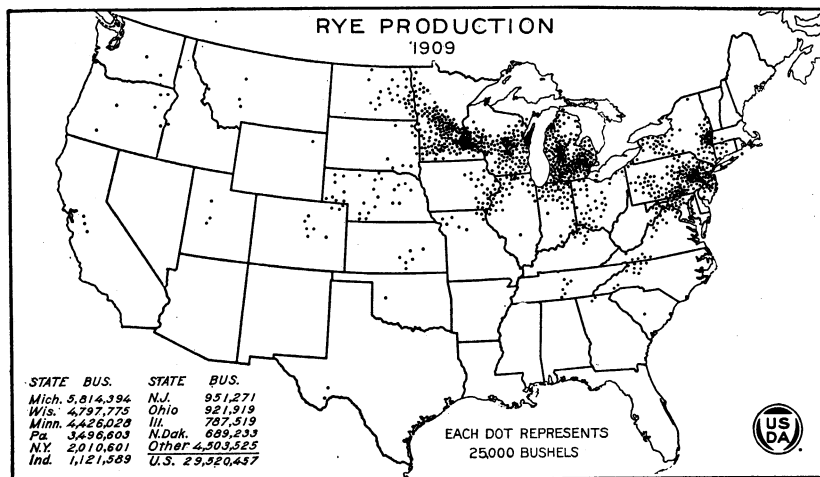


FIG. 1.—Outline map of the United States, showing the production of rye in 1909. Each dot represents 25,000 bushels.

the field would have exposed many of the egg clusters and destroyed them, whereas the unplowed fields serve as a protection for the eggs. A field of rye sown early makes an ideal spot for the deposition of grasshopper eggs. It has been observed that grasshoppers become more numerous where the acreage of winter rye is increased. In many sections, however, there is so much grassland in which the eggs can be deposited that the growing of rye has little effect on the number of grasshoppers.

Rye is more easily injured by hail after heading than wheat, oats, or barley, and the heads are more likely to be blasted by hot drying winds at blossoming time.

WHERE RYE IS ADAPTED.

Winter rye is the hardiest and earliest of all cereals, and successfully survives the winters even in the extremely cold sections of northern North Dakota and Montana. Its earliness frequently enables it

to escape injury from drought and rust. Rye sprouts more quickly and grows more vigorously than wheat at low temperatures, and consequently can be sown successfully at a much later date in the fall. It is better adapted to light sandy soils, acid soils, poor thin land, and poorly prepared seed beds than the other small grains. It produces a fair crop under adverse conditions where the other small grains would fail completely.

Rye can be grown in practically all parts of the United States, although it is more productive in some sections than in others. Its culture is limited in most regions because other crops are more profitable. It is most profitable in the Northern and Eastern States. North Dakota, Michigan, Minnesota, and Wisconsin now lead in the production of rye. (Figs. 1 and 2.) In the western half of the United States rye in general is best suited to the climatic and agricultural conditions in North Dakota, South Dakota, Minnesota, Nebraska,

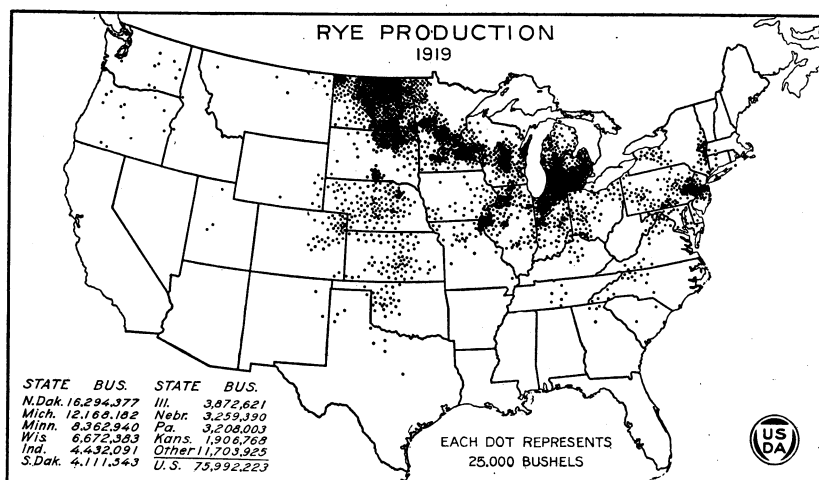


Fig. 2.—Outline map of the United States, showing the production of rye in 1919. Each dot represents 25,000 bushels. Note the great increase in rye production as compared to that in 1909 (Fig. 1), especially in the Great Plains States.

and northeastern Colorado. Hardy winter rye is successfully grown in all parts of the Dakotas and Minnesota, while winter wheat usually will not survive the winters in North Dakota, not always in Minnesota, and usually only in the southeastern and Black Hills sections of South Dakota. The greater hardiness of winter rye as compared with winter wheat in western South Dakota is shown in Figure 3. Rye is the best small-grain crop for the sandy lands of northeastern Colorado and adjacent States.

In the arid and frosty portions of the Great Basin and intermountain regions, particularly in the higher and drier sections of eastern Washington and Oregon, northern California, and in Wyoming, rye is more certain than other grain crops. It is grown there for both grain and hay. The hay serves as a winter feed for the range stock and is the only feed crop which can be grown with safety in the driest sections. In other parts of the western United States rye has a place as a pasture or hay crop or for soiling or green manure.

VARIETIES.

Although many varieties of rye have been introduced into the United States and several more have been developed in this country, much of the rye now grown is of unnamed varieties and is known only as spring rye or winter rye.

The named varieties usually are not uniform but contain kernels of several sizes and colors, including shades of yellow, green, bluish green, and brown. Variations of other parts of the plants also occur. Like corn, rye normally is a cross-fertilized plant, and very few of the rye flowers are naturally self-pollinated. Consequently all rye except recently selected strains produces a crop consisting of a mixture of several types. By the processes of this intercrossing and the survival of the most vigorous plants, rye may partly adapt itself to a given environment in a few years. For this reason home-grown seed usually gives the best results if it contains the types best adapted to the district where grown. All rye varieties are bearded, although



FIG. 3.—Plots of Kubanka spring wheat (1), Swedish winter rye (2), and Kharkof winter wheat (3) in western South Dakota. Note the differences in stand and growth between the winter rye and the winter wheat, due to the greater hardiness of the rye.

many of the beards drop off from some varieties at maturity, and some varieties have short beards. A beardless variety would be very desirable for hay.

Two distinct types of rye are commonly known, viz, winter rye and spring rye. The former is adapted for fall sowing only and usually will not mature seed from spring sowing except when sown very early (Fig. 4). Spring rye matures quickly from spring sowing but may not be hardy enough to survive the winters if sown in the fall. It is of the utmost importance to know whether one is obtaining winter or spring rye for seeding purposes.

As the kernels of winter and spring rye can not be distinguished except in the case of a few varieties such as Rosen, it is best to obtain seed from a reliable source in order to avoid a possible loss. Spring rye is of minor importance in most sections, so that mistakes in identity do not occur frequently, but authentic seed of spring rye often is difficult to obtain.

WINTER RYE.

Several varieties of winter rye have been grown in experiments in the western half of the United States, and most of them also are grown commercially. Many of the varieties have lost their identity on farms and are called simply winter rye. The leading varieties of winter rye are described in the following pages.

ROSEN.

Rosen rye was developed at the Michigan Agricultural Experiment Station by selection from a sample of rye sent from Russia by a Mr.

Rosen in 1909. This variety was first distributed from the Michigan station in 1912 and has since become the leading variety in Michigan and several other Northern States. Rosen is a rather late variety, with large well-filled heads and large, mostly dark-green, kernels. (Fig. 5.) It is slightly more winter hardy under most conditions than the leading varieties of hard winter wheat, but not as hardy as several other varieties of rye.

Rosen is the best adapted variety of winter rye in most of the Corn Belt region and in Michigan. It has given good results in Iowa and Nebraska, in the subhumid sections of Idaho and Washington, and in some other localities. In Kansas the ordinary Kansas winter rye seems to be as good as Rosen or better, both for grain and for pasture. Rosen apparently is not well adapted in the region south of Kansas. In North Dakota and Montana and in all except the southern portions of Minnesota, South Dakota, and Wisconsin Rosen usually is not sufficiently winter hardy and on the average is considerably outyielded by other varieties. Rosen rye usually yields well in these States following mild winters in which the crop is not winterkilled. In the semiarid sections of the Pacific coast and intermountain regions other varieties of rye which are earlier and of

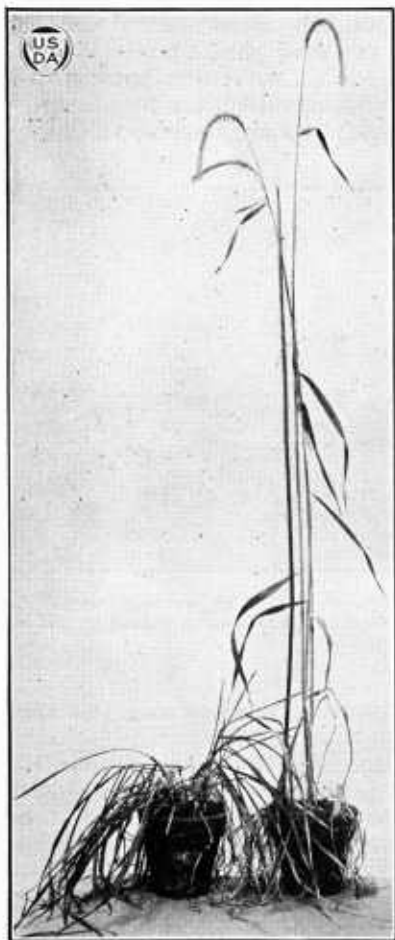


FIG. 4.—Plants of winter rye (left) and spring rye (right) four months after sowing in the spring. The winter rye has not even started to shoot.

less rank growth usually give better yields than Rosen. In the Cotton Belt of the South it is much inferior to Abruzzes and certain other varieties because of its late maturity.

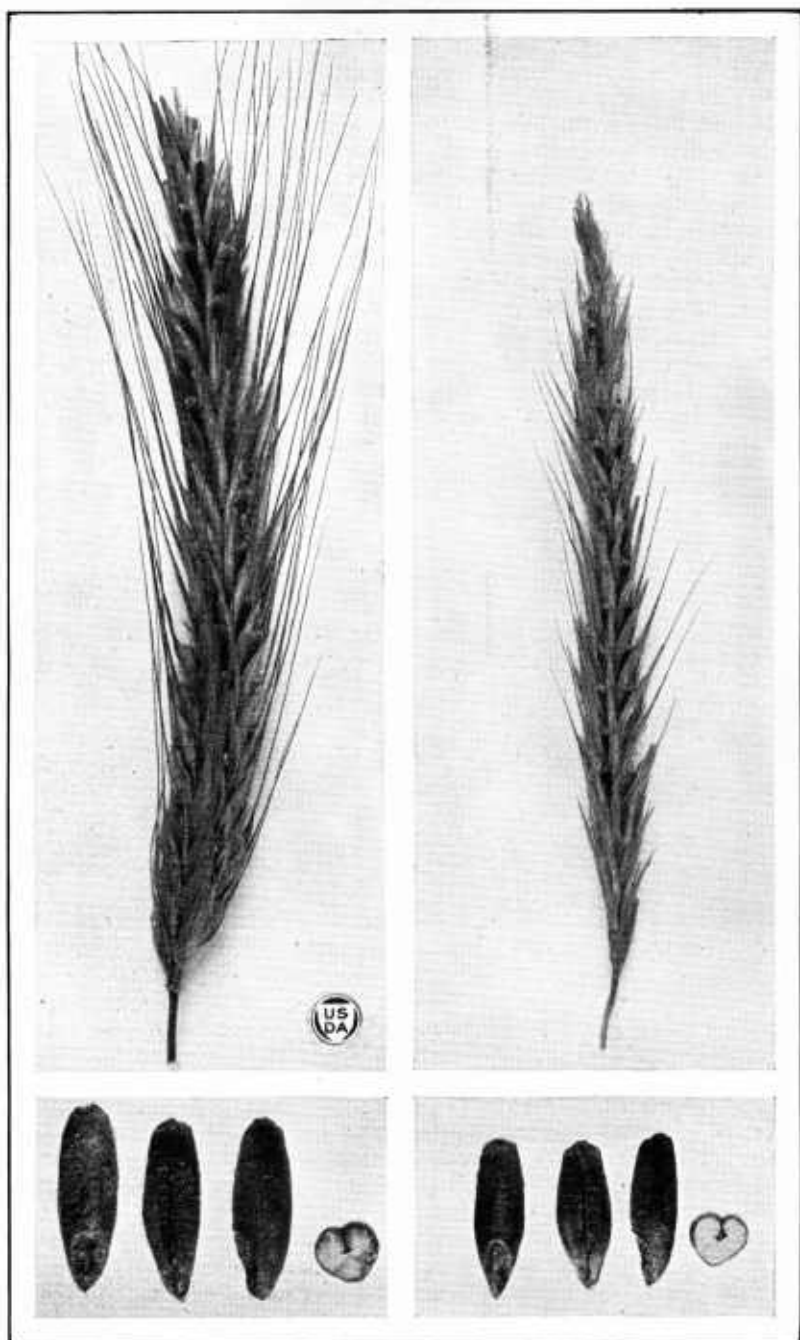


FIG. 5.—Heads and kernels of Rosen (left) and Dakold (right) winter rye. Heads natural size, kernels magnified 3 diameters.

DAKOLD.

The Dakold (North Dakota No. 959) rye was originated at the North Dakota Agricultural Experiment Station in 1902. It is the product of a few plants of rye found growing on land where winter wheat had been sown but had winterkilled. The rye was increased and later distributed to farmers in North Dakota as North Dakota No. 959, but the variety has recently been named Dakold. It is now widely grown in North Dakota and Canada.

This variety has small heads, small dark-colored kernels (Fig. 5), and rather slender stems. It matures early. A field of Dakold rye in shocks is shown in Figure 6.

Dakold rye is very hardy, perhaps as hardy as any known variety of rye. It survives the winters well in all parts of North Dakota and in some sections of Canada. It has outyielded all other varieties of rye in North Dakota on the average and is recommended for northern Montana, but outside of those States it is not equal to some other varieties.



Fig. 6.—A field of Dakold winter rye in shock near Fargo, N. Dak.

SWEDISH.

The Swedish (Minnesota No. 2) variety was developed by the Minnesota Agricultural Experiment Station from a sample of Swedish rye obtained from John Brogard, of Henning, Minn., in 1895. It is the result of the selection of the hardy plants which survived the winters of 1896-97 and subsequent seasons. It was first distributed to farmers in 1907 and has since become the leading variety of rye in Minnesota. In appearance, habits of growth, and hardiness Swedish is very similar to Dakold.

Swedish rye is best adapted to Minnesota. It is very hardy and nearly as productive as Dakold in North Dakota. It also has produced good yields under semiarid conditions in western South Dakota and eastern Washington, and under humid conditions in western Oregon.

DEAN.

Dean (Minnesota No. 1) rye was grown at the Minnesota Agricultural Experiment Station in 1900 and during subsequent years.

It was obtained by that station from W. M. Liggett, of Benson, Minn. A selection of this variety made at the Wisconsin Agricultural Experiment Station was distributed in Wisconsin as Pedigree No. 4 and is still grown in that State. Dean rye is very similar in all its characteristics to Swedish rye and is about equal to that variety in hardiness. The Dean variety has yielded nearly as well as Swedish in Minnesota and South Dakota. In the latter State, however, Advance, a selection from Dean, has outyielded the parent variety.

ADVANCE.

Advance rye originated as a selection from Dean made at the Highmore Substation of the South Dakota Agricultural Experiment Station in cooperative experiments with the Office of Cereal Investigations of the Bureau of Plant Industry, United States Department of Agriculture. The selection was made in 1911 and was first distributed to farmers in 1915. The Advance variety does not differ noticeably from Dean, Swedish, and Dakold. It is fully as hardy as Dean and Swedish and apparently about as hardy as Dakold. It has proved the most productive variety for central and eastern South Dakota, and also has produced good yields in North Dakota and central Oregon.

SCHLANSTEDT.

Schlanstedt rye was developed by Dr. Wilhelm Rimpau, of Schlanstedt, Germany. This variety was brought to this country by the United States Department of Agriculture in 1900 and was later distributed to farmers. Schlanstedt is not grown extensively now, but two selected strains of it are important in Wisconsin. One of these, known as Wisconsin Pedigree No. 2, was selected at the Wisconsin Agricultural Experiment Station. It was first distributed in that State in 1910 and has been grown in other States since that time. The other strain, Wisconsin Pedigree No. 12.19, was selected at the Ashland Branch Station of the Wisconsin Agricultural Experiment Station by E. J. Delwiche in 1912. It is somewhat shorter than Pedigree No. 2.

Pedigree No. 2 has not yielded as well as other varieties in the western half of the United States, although it is the most productive variety for southern Wisconsin. Pedigree No. 12.19, the most productive variety in northern Wisconsin, has produced good yields in experiments in the Red River Valley of North Dakota, although it is not yet grown there commercially.

KANSAS.

Kansas winter rye has been grown by farmers in Kansas for many years and by experiment stations since 1904. This variety apparently is equal or superior to all other varieties of rye which have been tested in Kansas. It also has yielded well in the Texas Panhandle.

GIANT WINTER.

The Giant Winter variety was introduced from France by the United States Department of Agriculture in 1901. It was distributed to farmers later, but is of minor importance in this country, as it has yielded little or no better than local varieties in most sections. In the western half of the United States it has produced the best results in southeastern Wyoming and northeastern Colorado.

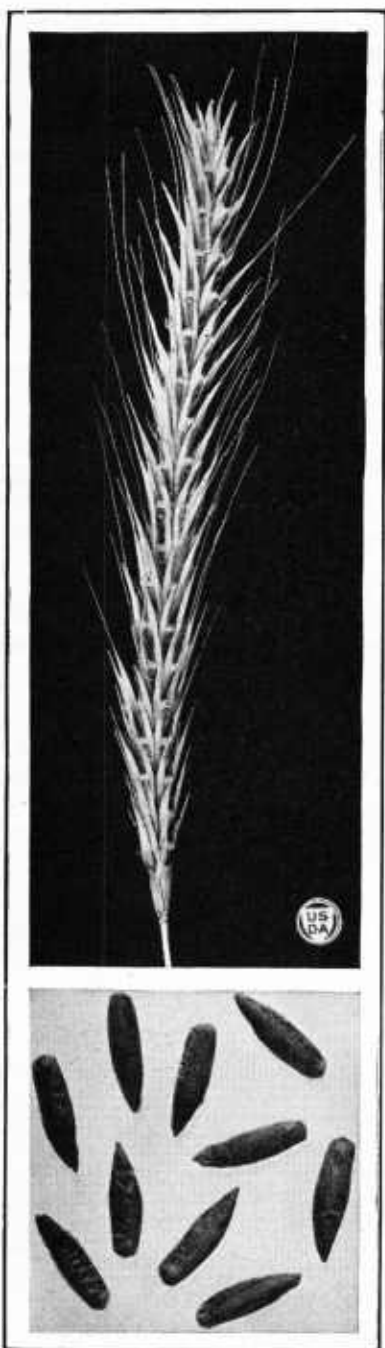


FIG. 7.—A head and kernels of Vern spring rye. Head natural size, kernels magnified about 3 diameters.

IVANOF.

The Ivanof rye was an important variety in northern Russia many years ago. It was introduced from Russia by the United States Department of Agriculture in 1898 and distributed later. It did not prove to be especially promising in this country and is not of much importance. A strain of Ivanof was selected and distributed by the Wisconsin Agricultural Experiment Station as Pedigree No. 3.

PETKUS.

The Petkus variety was developed by F. von Lokow, of estate Petkus, Baruth, Brandenburg, Germany, by selection carried on for 26 years. It was introduced into this country from Austria by the United States Department of Agriculture in 1900. Although it has since been distributed in the United States it has not become commercially important. A selection from this variety was developed and distributed by the Wisconsin Agricultural Experiment Station as Pedigree No. 1 and is still grown to some extent in Wisconsin.

OTHER VARIETIES.

Many other local or introduced varieties of rye have been grown in this country from time to time. They usually bear the name of a grower or seedsman or a geographical name. After these varieties have been grown in a section long enough for natural selection to have its effect they often become rather well adapted. A variety called Russian No. 9 has recently been distributed in North Dakota. Another variety named Star, which was developed at the Svalof Plant Breeding Station in Sweden, is now being grown to a slight extent in South Dakota.

SPRING RYE.

Spring rye is of minor importance in comparison with winter rye. Only in a very few isolated sections or in certain seasons does it yield as well as adapted varieties of winter rye. Spring rye sometimes outyields winter rye on clay land where the latter is injured by the heaving of the soil from freezing and thawing. It matures quickly and will produce seed from late-spring sowing, although early seeding gives the highest yields. Spring rye was formerly grown to a considerable extent in the northern States, but since the development of hardy varieties of winter rye it is of little consequence.

Spring rye is well suited to the dry lands in the high plateau districts of the Great Basin region in central Oregon and the adjacent sections of Idaho and California where late-spring frosts frequently injure winter rye at blossoming time. Spring rye also has produced fair returns on the sandy soils in northeastern Colorado and doubtless in other localities. There are no distinct varieties of spring rye in this country. Practically all of the spring rye grown is unnamed or else bears the name of a grower or seedsman. One local variety of spring rye formerly distributed by the United States Department of Agriculture recently has been named Vern. Two other varieties of spring rye have been developed in Canada but are not known to be grown in the United States.

VERN.

A supply of seed of spring rye was obtained by the United States Department of Agriculture in 1904 and again in 1905 from F. W. Boehme, of Geneva, Idaho. It was distributed immediately and has since been grown mostly under the designation S. P. I. No. 26101. A head and kernels of this rye, now named Vern, are shown in Figure 7. The Vern rye has been the most promising spring variety in eastern and central Oregon.

PREPARATION OF THE SOIL.

Rye will respond to good soil treatment, but one of its chief merits is its ability to produce a crop under adverse conditions. The principal reason for growing rye in many sections is its low cost of production. Consequently, extensive tillage in preparation for rye usually is not advisable.

Much of the rye grown in the western half of the United States is drilled into grain stubble without previous preparation. This is the most economical method, as the only expense involved is for the seed and the labor of seeding. The grain stubble holds the snows, which protect the rye and supply moisture in the spring. Rye should not be sown on very compact soil, owing to the difficulty of getting the drill to penetrate to a sufficient depth. Disking the stubble often is practiced, but if the field is reasonably free from weeds it usually will not pay for the additional labor, while if the field is very weedy rye should not be sown. Less snow will be caught and held if the stubble is disked.

The seeding of rye in stubble has the disadvantage of increasing the grasshopper menace, as previously mentioned. It also permits an increased growth of some weeds. The continued practice of stubbling in rye tends to decrease yields. Rye should, therefore, be sown on land which is not too weedy, and on farms where weeds are very numerous the stubbling-in practice should be discouraged.

Rye succeeds well on summer-fallowed land except during severe winters in North Dakota, where winterkilling may occur. The fallowed land does not hold the snow as well as stubble land or corn ground, and the crop thus receives less protection. In general, it is more profitable to seed the summer-fallowed land to wheat, oats, or barley than to rye, even though rye would yield well. Summer fallowing is not a profitable seed-bed preparation for spring grains or for winter rye in the Great Plains and Prairie regions. In the subhumid sections wheat sown on summer fallow is likely to lodge or be badly rusted, while winter rye is not greatly injured by either. Where winter wheat can survive the winters it should be sown on summer fallow in preference to rye.

In northeastern North Dakota summer fallowing often is necessary to control sow thistle, quackgrass, and Canada thistle. Winter rye sown on this fallow makes a rapid growth and serves to check the weeds which have survived the fallowing operation, and it is the best crop to grow on such land.

Fall plowing for rye, although commonly practiced in the East and to a considerable extent in the West, usually is not profitable in the western half of the United States because of the additional expense involved. The additional yields, if any, obtained from fall plowing will seldom compensate for the expense of plowing and harrowing, and this method also results in a delay in fall plowing for spring grains. In semiarid sections fall plowing and harrowing dries out the soil, making it much more difficult to secure a stand of winter rye than if the crop were sown on stubble. In subhumid sections fall plowing for winter rye is more successful.

Corn ground makes as ideal a seed bed for rye as for other small grains. It usually is preferable, however, to sow wheat, oats, or barley on the corn ground instead of rye, as the latter can be successfully sown on small-grain stubble, which is not always true of the other crops.

TIME OF SEEDING.

Winter rye can be sown at any time during the fall. If sown early, it will produce more fall pasture than if sown later. As a rule, rye should be sown at about the time winter wheat is sown, but the time of sowing is of less importance with rye than with wheat. Because of the ability of rye to germinate at low temperatures and with limited moisture, it can be sown safely at a later date than wheat. Late seeding, however, is somewhat risky. Winter rye sown very late sometimes does not emerge until spring, but even then may produce fair yields, though less than from earlier seeding. Winter rye sown in very early spring often matures seed, but the yields are less than from fall sowing. Sowing winter rye in the spring usually results in failure.

In general, the early or sometimes medium dates of seeding have produced the best results. Rye should be sown earlier in the North than in the South. In the northern part of North Dakota and Minnesota rye should be sown about August 15 to September 1. In the latitude of the southern part of North Dakota seeding from September 1 to 15 usually will give the best results. In most of South Dakota the best date is about September 15, in Nebraska

from September 15 to October 1, in Kansas about October 1, and south of Kansas from October 1 to November 1.

In the mild sections of the Pacific Coast States seeding can be done much later than at points in the intermountain and Great Plains areas at the same latitude. Although late seeding sometimes has been very satisfactory, better results on the average will be secured from earlier seeding.

Spring rye should be sown as early as the soil conditions permit. Early seeding almost always results in the highest yields of grain.

METHOD OF SEEDING.

For best results rye should be sown with a grain drill at a depth of $1\frac{1}{2}$ to $2\frac{1}{2}$ inches. On stubble land a single-disk drill will penetrate best, while on a well-prepared seed bed other types of drills are equally satisfactory. On fallowed land the hoe drills give excellent results, because they stir the soil less than other types and leave the surface corrugated, which checks soil blowing.

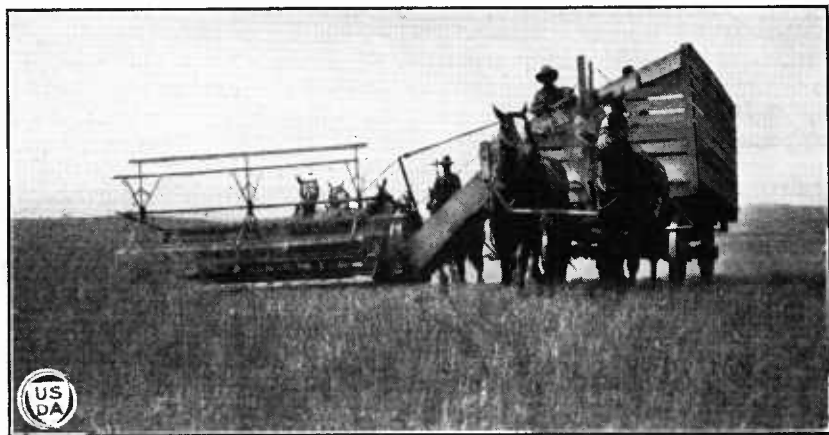


FIG. 8.—Harvesting winter rye with a header in western North Dakota.

RATE OF SEEDING.

The rate of seeding best suited to the growing of rye in the western half of the United States is about the same as for wheat. Late seeding should be thicker than early seeding, and thick seeding is preferable to medium or thin seeding when the crop is grown for pasture, green manure, soiling, or hay.

Under semiarid conditions 3 to 4 pecks per acre is sufficient, for subhumid conditions about 5 pecks, while for humid or irrigated conditions 6 pecks is more satisfactory.

HARVESTING AND THRESHING.

Rye should be harvested when the first kernels are ripe. If harvested in the stiff-dough stage threshing is more difficult. If the crop is left standing until it is dead ripe there will be a considerable loss from the shattering of grain. Rye may be harvested with either a header or binder. The former method is more economical, espe-

cially when the crop is short. A field of rye being harvested with a header is shown in Figure 8. In the western half of the United States rye seldom becomes too tall to harvest with a binder, and most of the crop is cut with that machine.

Practically all the rye grown in the West is threshed with the ordinary threshing machine. If unbroken straw is wanted, a special threshing machine is used.² Well-matured rye is easily threshed from the heads, so that the full set of concave teeth is not required. The straw of rye usually is long and tough, however, so that fully as much power is required to thresh rye as is necessary for other grains.

USES OF RYE.

Most of the rye consumed in this country is ground into flour, and the flour usually is mixed with wheat flour to make rye bread. In Europe rye bread is a common food product, and a considerable portion of the rye bread made in this country is consumed by immigrants from Europe.

During recent years a large part of our rye crop has been exported to Europe for human consumption. When the rye crop is short in Europe a heavy demand arises for American rye. This provides an outlet for the surplus rye in the United States and largely controls the market for our crop. In some years less than 1 per cent of the rye grown was exported, while in years of deficiency a larger proportion has been shipped abroad. Since 1914 the annual exports during each fiscal year ending June 30 have comprised from 28 per cent in 1916 to 78 per cent in 1920 of our production during the same calendar years.

Rye is not a suitable concentrated feed for livestock, unless mixed with other grains. It is too heavy and sticky and is not very palatable. Rye shorts or rye-feed by-products of flour making also should be mixed with other feeds. When fed in mixtures rye has a feeding value lower than corn but nearly equal to that of barley. Not more than 4 pounds of rye per animal per day should be fed.

Rye makes a satisfactory hay for feeding purposes when cut sufficiently early, although it is less palatable than the hays made from legumes and the better grasses and grains and inferior to them. The rye stems are hairy and frequently coarse and tough and are not greatly relished by animals which have access to other forage. The value of rye as a hay crop lies in its ability to grow where other crops are not productive and to furnish an early hay crop. Rye is a less palatable pasture crop than wheat and most grasses, but is consumed readily when other feed is not available.

Rye straw is useful for the bedding of livestock and also has some value as feed. These are about the only uses made of it in the western half of the United States. When rye is to be used for stuffing horse collars or for packing nursery trees it is threshed with a special machine which leaves the straw straight and unbroken.

² This machine is described and illustrated in *Farmers' Bulletin 756, Culture of Rye in the Eastern Half of the United States.*

PESTS AND DISEASES.

Many of the insect and rodent pests attacking rye are the same as those which attack other small grains, and the same methods of control are applicable. Except in the case of ergot and stem smut, diseases cause relatively little injury to the rye crop. Both stem and leaf rusts attack rye, but usually the injury is not great, owing to the early maturity of the crop, which enables it to escape serious damage. Loose smut of rye is of rare occurrence and of little or no economic importance. Stem smut, although also of rare occurrence, is somewhat more destructive. Ergot causes serious losses in rye. This disease is characterized by large purplish black bodies occupying

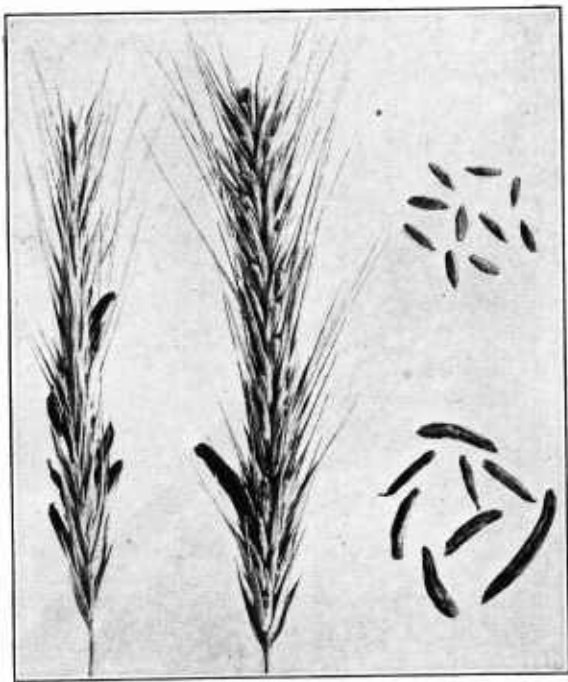


FIG. 9.—Heads of rye showing ergot; also kernels of rye, sound (above) and ergotized (below).

the spaces in the heads where the kernels should be. (Fig. 9.) Ergot can be controlled by sowing ergot-free seed on soil where rye has not been grown for a year or two previously. The ergot bodies may be removed from the rye by stirring the grain in a 20 per cent solution of common salt and skimming off the ergot, which rises to the surface. The salt solution should be drained off and the rye washed with water, after which it can be sown. The ergot loses its viability after a year, so that if year-old seed of rye is sown there is little likelihood of ergot infection. Using the year-old seed or ergot-free seed is the most feasible method of control. The ergot is poisonous to both human beings and livestock, and rye containing any appreciable quantity (one-half of 1 per cent or more) of ergot should not be used for food or feed. Ergot often causes abortion in pregnant animals.

RETURNS.

In the important rye-producing Western States the average acre value of the rye crop is somewhat less than that of wheat. The yields of rye usually are higher than those of wheat, but the price is much less. The net acre returns from rye often are higher than from wheat because of the lower cost of production. The price of rye is determined largely by the foreign demand, and with the resumption of normal production in Europe the demand for the American crop probably will be lessened. At low prices rye can not be grown for grain at a profit except under good management and in favored localities, but this crop will continue to have a wide use on sandy lands and for pasturage, hay, green manure, and as a nurse crop for legumes.

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